PLANETS

OPERATING MANUAL

MODEL FTS 1050A

QUARTZ FREQUENCY STANDARD

Option Coverage:

001 100 kHz Output
002 Internal Standby Battery and Automatic Charger
003 1 PPS Output

FTS Part Number: 06686-001-00000

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CHAPTER 1 GENERAL INFORMATION

1.1 INTRODUCTION

1.1.1 Scope of Manual

This manual (FTS Part Number 06686-001-00000) provides detailed instructions for installing and operating the FTS 1050A Quartz Frequency Standard.

The manual is configured as follows:

Chapter 1 General Information
A general description of the instrument, technical specifications, theory of operation.

Chapter 2 Installation
Instructions for inspecting, unpacking, and making external connections.

Chapter 3 Operation
Turn-on and turn-off instructions, descriptions for all indicators, monitors, and controls.

Chapter 4 Maintenance
Reshipping information, troubleshooting guidelines, and routine maintenance.

Chapter 5 Options
Information for standard FTS 1050A options.

1.1.2 Configurations Covered

Chapters 1 through 4 apply to the base configuration of the instrument. Information pertaining to options, is supplied in Chapter 5. When information in the main manual and Chapter 5 differ, Chapter 5 shall govern.

1.1.3 Warranty Information

Frequency and Time Systems, Inc. warrants that this product is free from defects in material and workmanship for a period of one year from the original date of delivery. Warranty service will be performed on the unit at the FTS factory (unless the return of only a subassembly is authorized by FTS), or, at FTS' discretion, in the field. Upon return to the factory, FTS will, at no further expense to the customer, repair or replace (at FTS' option) the unit or subassembly provided that the unit or subassembly has not been improperly installed, maintained, interfaced, or operated outside of its environmental specifications or otherwised misused and has not been repaired or modified without authorization by FTS.

The customer shall prepay shipping charges for units returned to FTS, and FTS shall pay for the return of the repaired or replaced unit to the customer.

1.2 INSTRUMENT INDENTIFICATION

The instrument is designated with a four or five digit model number (1050A). A slash (/) and a three digit number following the model number, specifies an option that is supplied within the instrument. The instrument model number and serial number appear on an adhesive label that is located on the instrument side panel.

1.3 INSTRUMENT DESCRIPTION

The FTS 1050A is a precision Quartz Frequency Standard (see Figure 1-1 for an illustration). It contains a precision quartz crystal oscillator and provides independently buffered sinusoidal output signals at frequencies of 1 MHz, 5 MHz, and 10 MHz (1 each). Refer to Table 1-1 for instrument specifications.

The output frequency can be adjusted over a total range of $4x10^{-7}$ with a resolution of $4x10^{-12}$. This adjustment can be made using a front panel switch assembly or an externally applied control voltage (0 to +10 V dc).

The instrument front panel provides indicators showing when AC power is applied and when the oscillator has warmed-up. A front panel meter and thumbwheel switch assembly, allow monitoring of the quartz crystal oven monitor voltage, the oscillator frequency control voltage, and the supply voltage.

The FTS 1050A is rack-mountable and measures ≈ 19"x3.5"x16.8". The front panel contains:

- LED indicators
- Monitors
- Frequency controls

The rear panel contains:

- Signal output connectors
- An external control voltage input connector
- Power connectors
- Fuses

The FTS 1050A is normally operated from a 115 or 230 V ac, 47 to 400 Hz source. The instrument can also be powered with a DC input from 26 to 30 V.

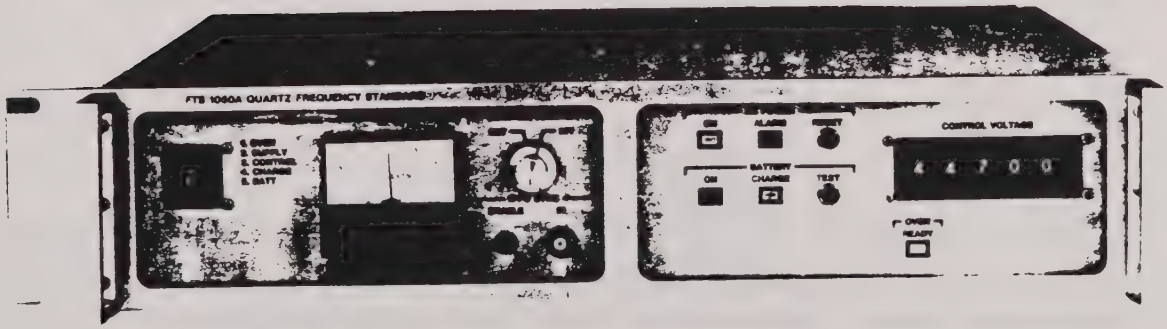

Figure 1-1 FTS 1050A Quartz Frequency Standard (Shown with Options 002 and 003)

1.4 SPECIFICATIONS

Table 1-1 Specifications FTS 1050A Quartz Frequency Standard

Parameter	Specification
Outputs	1 MHz, 5 MHz, and 10 MHz
Output Amplitude/50 Ω	1 V rms
Harmonic Distortion	-40 dB
Spurious Signals:	
5 MHz	-80 dB
1 MHz, 10 MHz	-70 dB
Aging Per Day (see note 1)	
Short Term Stability	$1x10^{-10}$
For averaging time of:	
1 s	$1x10^{-12}$
10 s	$1x10^{-12}$
100 s	$1x10^{-12}$
SSB Phase Noise (BW = 1 Hz)	
For offset from signal of:	
(5 MHz output) 1 Hz	-116 dBc
10 Hz	-140 dBc
100 Hz	-150 dBc
1 kHz	-157 dBc
10 kHz	-160 dBc
Frequency Adjustment Range	
Front of Panel (5 digit)	$4x10^{-7}$
Maximum Frequency Change as a Function of:	
Operating Temperature	$1x10^{-9}$
Load Change (50 Ω ± 10%)	$5x10^{-11}$
Operating Temperature Range	0 to 50 °C
Non-Operating Temperature Range	-60 to 80 °C
Power Requirements	
AC Input	115 or 230 V ± 10%
	47 to 400 Hz
	20 W (typ.) at 25 °C
DC Input	26 to 30 V dc
	8 W (typ.) at 25 °C
Dimensions	
Height	3.5" (89 mm)
Width	19" (483 mm)
Depth	18" (457 mm)
Weight	20 lb (9.1 kg)

Note 1: Aging typically improves to a level of parts in 10^{11} per day. Aging rates as low as $1x10^{-12}$ have been observed after years of unperturbed operation.

1.5 FUNCTIONAL DESCRIPTION

Figure 1-2 is a block diagram of the FTS 1050A Quartz Frequency Standard.

The FTS 1050A consists of the following functional blocks:

- Oscillator Assembly
- RF Assembly
- Monitor PCB Assembly
- Front Panel Controls and Monitors
- AC Power Supply

1.5.1 Signal Distribution

The main assemblies for generating user output signals are the Oscillator and the RF Assemblies.

The oscillator contains an SC-cut crystal and an integral controller oven. This maintains the crystal at its operating point over a wide range of ambient temperatures. The oscillator provides two independently buffered 5 MHz sinusoidal signals. One signal is directly available to the user via the rear panel; the other provides a reference input to the RF Assembly.

A frequency control voltage is accepted by the oscillator, from one of two sources; the front panel CONTROL VOLTAGE switch assembly or an external (0 to 10 V) input. A front panel switch allows the user to select between sources.

The RF Assembly accepts the 5 MHz reference signal from the oscillator. This assembly contains a 1 and 10 MHz PCB assembly that doubles the 5 MHz signal to 10 MHz and divides it to 1 MHz, producing buffered user outputs.

The Monitor PCB Assembly:

- Accepts external DC and AC power inputs and automatically switches between them (priority is AC).
- Provides monitoring circuitry and interfacing to the front panel meter and meter select switch assembly.
- Provides a 10 V reference for the oscillator control voltage.
- Regulates power to the oscillator.
- Contains circuitry to reset the AC ALARM LED indicator.

1.5.2 Power Distribution

AC input power is converted to an unregulated DC voltage (+22 to +30 V) by the AC power supply. This voltage and the externally applied DC power, are applied to the Monitor PCB Assembly. The instrument normally operates from AC power. If AC power is interrupted, DC power is used (if available) until AC is restored.

A power regulator supplies the oscillator with +22 V and is controlled by the Monitor PCB Assembly during crystal oven warm-up. The power regulator also supplies power to the Front Panel and RF Assemblies.

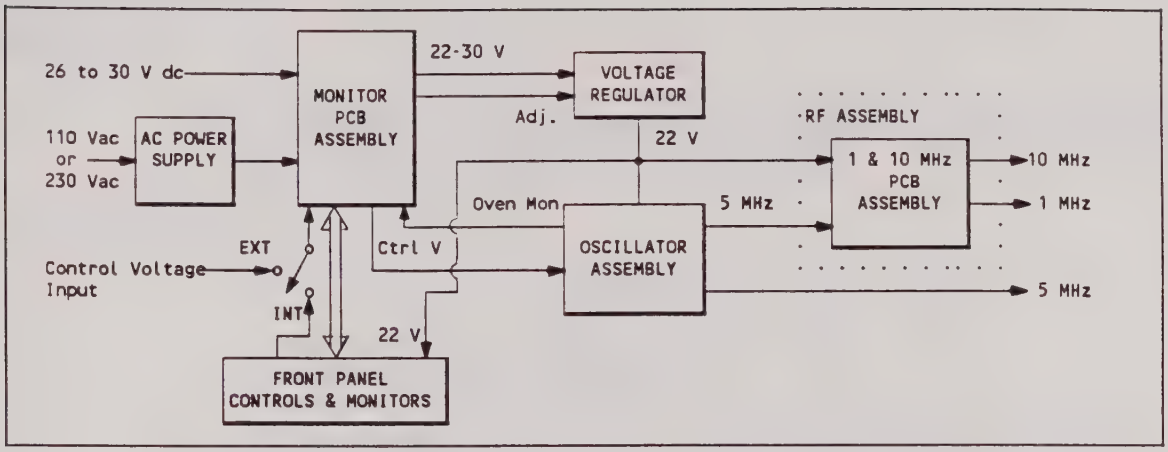

Figure 1-2 FTS 1050A Quartz Frequency Standard Block Diagram (no options)

CHAPTER 2 INSTALLATION

2.1 INTRODUCTION

This chapter provides information for inspecting, installing, and making connections to the FTS 1050A. The FTS 1050A requires no special equipment for installation and handling. Figure 2-1 shows the outline dimensions of the instrument. Three additional inches are required at the rear panel to attach power and signal cables.

2.2 UNPACKING/INSPECTION

CAUTION!

Static electricity can damage electronic circuitry! Use proper static precautions when handling the instrument.

Unpack all equipment carefully and check it against the purchase order for completeness.

If the shipping carton is damaged, inspect the equipment for damage. If you suspect that it was damaged in transit, notify Frequency and Time Systems and the carrier who delivered the equipment. Retain the shipping carton and packing material for the carrier's inspection.

2.3 SUPPLIED EQUIPMENT

The following items are supplied with the FTS 1050A:

Item	Qty	Part Number
AC power cord	1	17250 (Belden)
DC power input mating connector	1	MS3106A-14S-23 (Cannon)
DC power output mating connector	1	MS3102A-14S-2P (Cannon)
Fuse; 1 Amp, 250 V	5	318001 (Littlefuse)
Fuse; 1 Amp, 250 V, Slo-blo	5	315001 (Littlefuse)

2.4 RACK MOUNTING

The FTS 1050A front panel contains mounting ears for attaching to a standard 19" instrument or relay rack. Each ear has two slotted openings that accept #10 screws.

The sides of the FTS 1050A are equipped with threaded holes for attaching rack slides (4, #10 holes per side). An FTS 6013 Slide Rack Accessory kit is recommended for mounting to a rack.

2.4.1 Rack-Slide Mounting Procedure

This procedure is applicable for mounting the FTS 6013 Rack Slide Kit to the FTS 1050A. Materials included in the kit are:

Rack Slides; (2 slides; 3 sections/slide)	part number 03790-701
Rack Slide Spacers (2)	part number 03770-701
Connecting Hardware	part of 03790-701

1) Separate the Flange Mount sections (B) from each rack slide assembly. Refer to Figure 2-2 Rack Slide Assembly Diagram.

2) Attach the end brackets and bar nuts connecting hardware to the rear of the instrument rack per Figure 2-2.

3) Place four machine screws (#10-32 x 3/8) in the first four holes of both Inner Chassis sections (A). Leave the hole behind the stop tab open on each assembly.

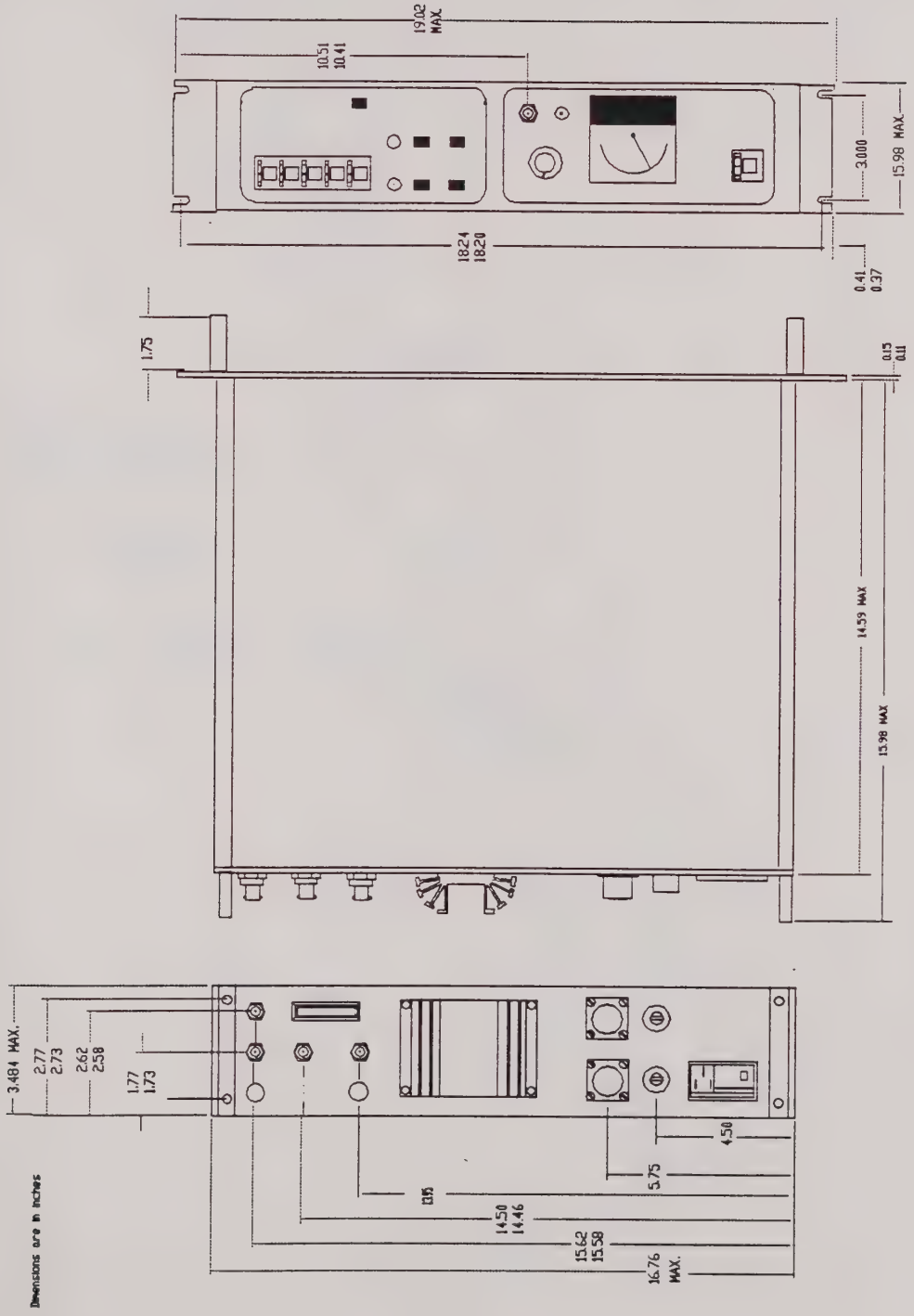

Figure 2-1 FTS 1050A Outline Diagram

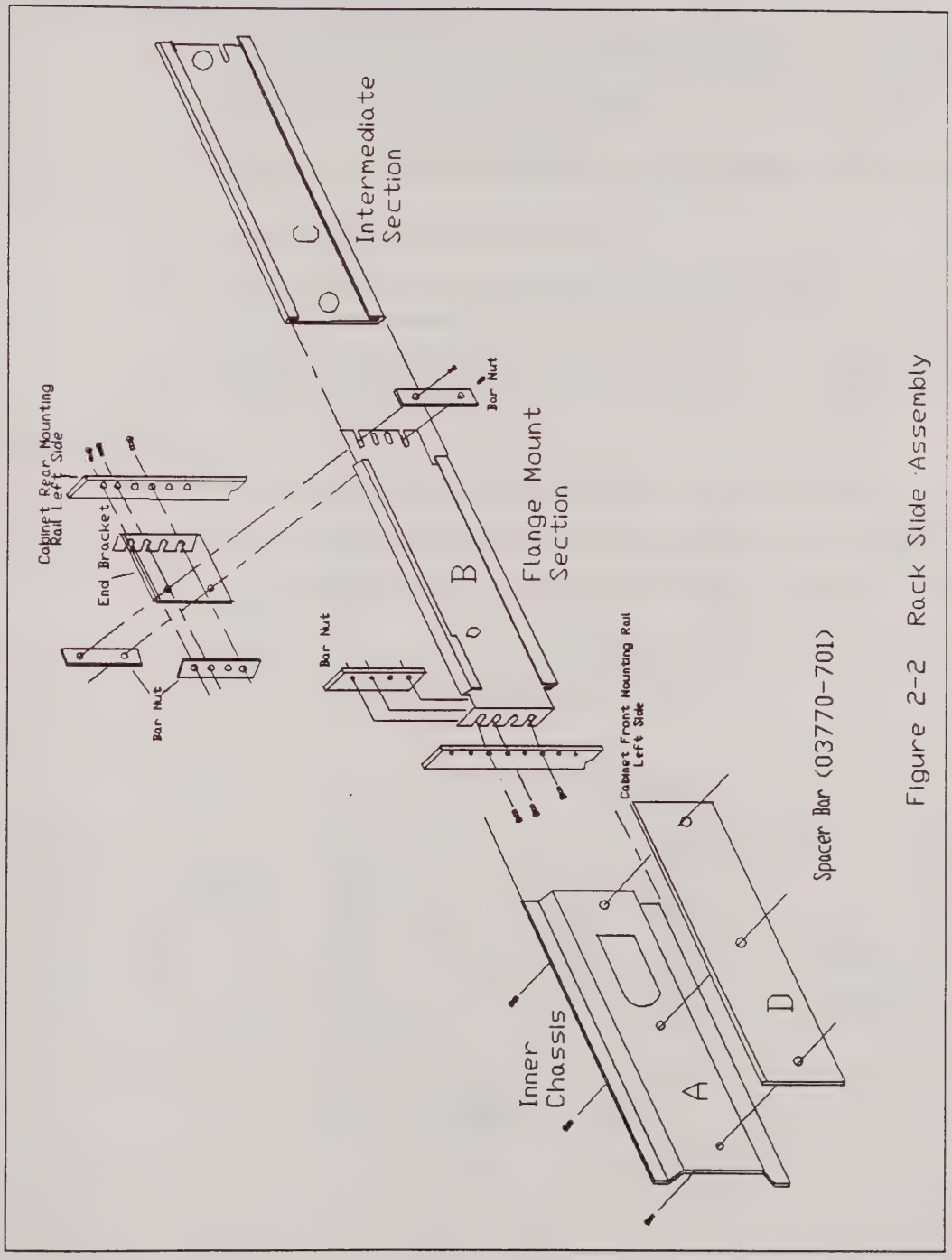

Figure 2-2 Rack Slide Assembly

2.4.1 Rack-Slide Mounting Procedure (continued)

4) Place an spacer bar (D) over the four exposed screws on each Inner chassis section.

5) Attach both Inner Chassis sections with spacer bars, to the sides of the FTS 1050A by tightening the screws into the holes provided.

6) Insert the Intermediate slide sections (C) within the Flange Mount sections past the stop tabs.

7) Secure the Flange Mount sections to the rack.

8) Slide the FTS 1050A into the tracks of the mounted rack sections. When the slides lock, depress the stop tabs and push the FTS 1050A the rest of the way into the rack.

9) Secure the FTS 1050A to the rack with four screws placed through the slotted openings on the instrument's front panel.

2.4.2 Demounting Procedure

1) Remove the four front panel screws securing the FTS 1050A to the rack.

2) Slide the instrument outward (away from the rack) until the slide sections lock.

3) Press the slide rack stops to release the lock and pull the instrument outward past the stops.

4) Continue to pull forward until the instrument is free from the rack slides. The Inner slide sections stay attached to the sides of the FTS 1050A.

2.5 CONNECTIONS

Figure 2-3 is an illustration of the FTS 1050A rear panel.

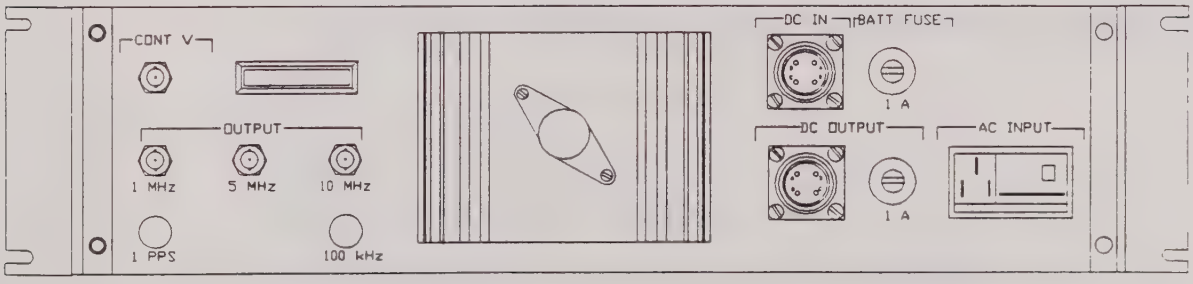

Figure 2-3 FTS 1050A Rear Panel

2.5.1 AC Power

The FTS 1050A operates from 120 ± 10 V ac or 230 ± 10 V ac. Line frequency can be from 47 to 440 Hz. The AC input is equipped with a line voltage selector card, a three-prong power receptacle, and a fuse holder with a fuse pull lever (refer to Figure 2-4).

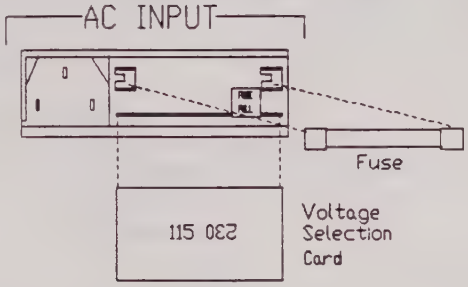

Figure 2-4 AC Power Connector

Use the following procedure for connecting AC power:

NOTE: There is no power switch for the FTS 1050A. The instrument is operational as soon as power is applied.

1) Locate the AC INPUT connector on the instrument rear panel and check that the line voltage selector PCB is in the proper position. Either 115 or 230 should be visible. The positions are as follows:

Vin	Card Position
110 to 130 V ac	115
220 to 240 V ac	230

If the card is in the wrong position, pull the card straight out (gently) using flat-nosed pliers, turn the card around so that the selected line voltage marking (115 or 230) is right-side-up when reading it (do not turn the card upside down), and re-insert the card into the connector.

2) Insert a fuse into the fuse holder after verifying that it is the proper rating. Use a 1 A fuse for 110 to 130 V ac; a 500 mA fuse for 220 to 240 V ac.

3) Connect the power cord (provided) to the three-prong receptacle.

4) Plug the power cord into a power outlet.

5) Verify that the AC POWER ON indicator is lit.

NOTE: The AC ALARM indicator is also lit and remains lit until manually reset.

6) Press the front panel AC RESET switch to turn off the AC ALARM indicator.

2.5.2 DC Power

The FTS 1050A can operate from an external +26 to +30 V dc source capable of supplying 2 A. DC power is applied to a rear panel, 4-pin circular (MS3102A-14P-2S) connector. A mating connector (MS3102A-14S-2S) is provided for constructing a power cable. Refer to Figure 2-5 for an illustration of this connector.

The DC IN connector pin-out is:

Pin #	Function
A	22 to 30 V dc positive
B	No Connection
C	Return
D	No Connection

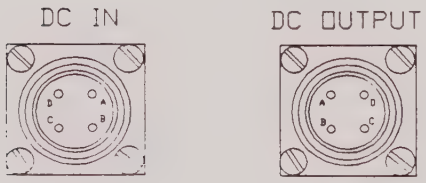

Figure 2-5 DC Power Connections

Use the following procedure for connecting DC power:

1) Locate the DC IN connector on the rear panel.

2) Attach a power cable equipped with a mating circular connector, to the DC IN connector.

NOTE: This input is protected against polarity reversal, but is not fused. It is suggested that the DC power source be current limited at 2 A.

The FTS 1050A can be operated on DC power by removing the AC power input. If only DC power is used, verify that the front panel AC POWER ON indicator is off and that the AC ALARM indicator is on.

2.5.3 DC Output Power

The DC OUTPUT provides a fused 22 to 30 V dc (1 A max.) output for powering accessories. The connector is a 4-pin circular connector (PN MS3102A-14S-2S). Refer to Figure 2-5 for an illustration of the connector. A mating connector (MS3106A-14S-2P) is provided for constructing a power cable.

The DC OUT connector pin-out is:

Pin #	Function
A	22 to 30 V dc positive
B	No Connection
C	Return
D	No Connection

2.5.4 Output Signals

All output signals (1, 5, and 10 MHz) are available on rear panel BNC connectors. Each output is 1 V rms/50 Ω, independently buffered, and short-circuit protected. Terminate the outputs with 50 Ω when applying them to electronic measuring equipment.

There are two plugged holes beneath the output BNC connectors, that are reserved for the 100 kHz (Option 001) and the 1 PPS (Option 003) outputs.

2.5.5 Control Voltage Input

An external control voltage of 0 to +10 V dc can be applied to the rear panel CONT V BNC connector. Input voltages outside of the 0 and +10 V dc range can damage internal circuitry!

CHAPTER 3 OPERATION

3.1 INTRODUCTION

This Chapter describes detailed procedures for turn-on, frequency tuning, operation with external DC power, and turn-off. Normal operational status is defined as operating from AC power with DC power applied as a backup, front panel control voltage switches employed, and the oscillator warmed-up.

3.2 TURN ON AND WARM-UP

To turn on the instrument:

1) Follow the steps listed in paragraph 2.4.1 if operating from AC power.

2) Follow the steps listed in paragraph 2.4.2 if operating from DC power.

3) Follow the steps listed in paragraph 2.4.1 then paragraph 2.4.2 if operating from AC power and using DC power for backup.

The instrument takes approximately 30 minutes to reach an accuracy of $2x10^{-8}$/day and 30 days to reach $1x10^{-10}$/day. When the oscillator's crystal oven is close to its operating temperature the OVEN READY indicator blinks. When the oven has reached equilibrium, this indicator is on.

3.3 TURN-OFF AND RESTART

To turn off the FTS 1050A, remove AC and external DC (if applied) power from the rear panel. To restart, re-apply AC and/or DC power to the instrument.

NOTE: The AC RESET switch must be pressed to clear the AC POWER ALARM.

The oscillator may warm-up in less than 30 minutes, as indicated by the OVEN READY LED, if power is removed for only a short amount of time.

NOTE: Repeated cycling of power may damage the oscillator!

3.4 FRONT PANEL

Figure 3-1 is an illustration of the FTS 1050A front panel. Items are indexed and cross-referenced in the paragraphs that follow. Some items are listed as not applicable (N/A). They are reserved for instrument Options and are detailed in the applicable section of the Options Chapter (Chapter 5.0).

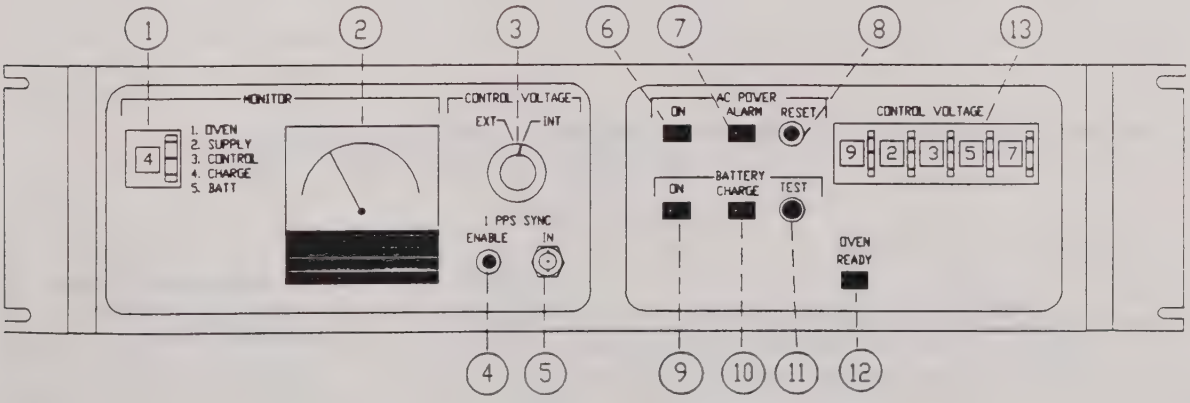

Figure 3-1 FTS 1050A Front Panel

3.4.1 Indicators

Table 3-1 describes the indicators supplied on the FTS 1050A front panel.

Table 3-1 Indicators

Item#	Designation	Color	Normal Status	Description
6	AC POWER ON	Green	ON	ON = FTS 1050A is operating from AC power.
7	AC POWER ALARM	Red	OFF	ON = AC power has been interrupted. This indicator stays on until reset by the operator.
12	OVEN READY	Green	ON	ON steady = Crystal oven is at operating temperature. ON blinking = Crystal oven is approaching equilibrium.
9	BATTERY ON	Green	N/A	Reserved for Battery option
10	BATTERY CHARGE	Yellow	N/A	Reserved for Battery option

3.4.2 Controls

Table 3-2 describes the front panel controls for the FTS 1050A. Controls listed as reserved are described in the appropriate section of the Options Chapter.

Table 3-2 Controls

Item#	Designation	Description
3	CONTROL VOLTAGE EXT CONTROL VOLTAGE INT	Selects the externally applied voltage as the frequency control source. Selects the front panel CONTROL VOLTAGE switch assembly as the frequency control source.
8	AC POWER RESET	Clears the AC POWER ALARM indicator if AC power is applied.
13	CONTROL VOLTAGE	5-position thumbwheel switch assembly. Used for tuning the oscillator. Maximum tuning range is 4×10^{-7} with a minimal increment of 4×10^{-12}.
11	BATTERY TEST	Reserved for Battery Option
4	1 PPS SYNC	Reserved for 1 PPS Option

3.4.3 Monitors

Table 3-3 describes the two front panel items used for monitoring operating parameters. Table 3-4 describes the functions for each monitor.

Table 3-3 Monitors

Item#	Designation	Description
1	MONITOR (select switch)	5-position thumbwheel switch used for selecting the parameter to be shown on the meter.
2	MONITOR (meter)	Scaled analog meter for displaying selected monitor. Scale is from -5 to +5 V.

Table 3-4 Monitor Switch Positions

Pos.#	Designation	Range	Normal	Description
1	OVEN	0 to 5 V	3.3 to 3.7 V	Represents the crystal oven temperature. Triggers OVEN READY indicator when <3.7 V. This monitor reading is initially about 5 V and falls as the oven temperature is raised.
2	SUPPLY	0 to 5 V	2.0 to 2.4 V	Represents the regulated supply voltage to the 1050A's electronics. Should be ≈3.1 V during warm-up. Scale factor: 1/10
3	CONTROL	0 to 5 V	1 to 4 V	Represents the control voltage applied to the oscillator. The meter reading is 1/2 of the control voltage applied to the oscillator.
4	CHARGE	N/A	N/A	Reserved for Battery Option
5	BATT	N/A	N/A	Reserved for Battery Option

3.4.4 External Connections

The BNC connector labeled 1 PPS SYNC IN (Item 5) is reserved for the 1 PPS Option.

3.5 FREQUENCY ADJUSTMENTS

3.5.1 Internal

The FTS 1050A is shipped with the CONTROL VOLTAGE switches preset to center the oscillator. Note the initial setting before changing any switch positions!

NOTE: Allow 24 hours after turn-on, for the oscillator to settle, before making a frequency adjustment.

The output signal frequencies can be offset by a total range of $\approx 4 \times 10^{-7}$ with a minimum increment of 4×10^{-12}. All outputs are affected equally by this adjustment.

Adjustment is done by changing the front panel CONTROL VOLTAGE setting. Refer to Figure 3-2 for an illustration of the switch assembly. The frequency adjustment increments are as follows:

Switch #	Increment/Step
1	4×10^{-12}
2	4×10^{-11}
3	4×10^{-10}
4	4×10^{-9}
5	4×10^{-8}

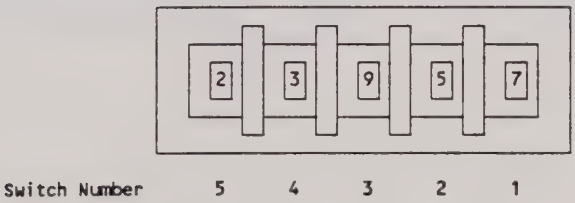

Figure 3-2 CONTROL VOLTAGE Switch Assembly

NOTE: These switches are only active when the CONTROL VOLTAGE EXT/INT switch is in the INT position.

3.5.1.1 Internal frequency adjustment procedure.

This procedure assumes that the operator is familiar with standard methods of measuring frequency offsets of parts in 10^{12}.

To adjust the output frequencies:

1) Set the CONTROL VOLTAGE EXT/INT switch to the INT position.

2) Measure the frequency offset.

3) Divide the absolute value of the offset by $4x10^{-12}$ (the least Increment/Step).

   The result is the number of positions that the switch settings will change. See Section 3.5.1 for a cross-reference between switch number and Increment/Step.

4) Change the affected switches by the amounts determined in Step 3, as follows:

   If the internal oscillator frequency offset is positive, decrease the switch settings.

   If the internal oscillator frequency offset is negative, increase the switch settings.

5) Repeat Steps 2 through 4 until the frequency offset is $<4x10^{-12}$.

FREQUENCY ADJUSTMENT EXAMPLE:

Frequency offset = -7.0×10^{-10}

$7.0 \times 10^{-10} \div 4 \times 10^{-12} = 175$ (result)

Switch #	5	4	3	2	1	
	5	4	2	2	3	(Initial Setting)
+	0	0	1	7	5	(*Change in Switch Settings)
	5	4	3	9	8	(New Switch Setting)

*The change is positive because the frequency offset is negative.

3.5.2 External

CAUTION!

Do not apply a control voltage outside of the range of 0 to +10 V dc. Internal circuitry damage can result.

External electronic frequency control is implemented by connecting a source of 0 to +10 V dc to the rear panel BNC connector labeled CONT V and selecting EXT on the front panel CONTROL VOLTAGE EXT/INT switch. The internal CONTROL VOLTAGE switch assembly is disabled when EXT is selected.

CHAPTER 4 MAINTENANCE

4.1 RE-ORDERING INFORMATION

To reorder any subassembly, contact the Marketing Department at Frequency and Time Systems. Supply the Assembly name and FTS Part Number for the subassembly along with the purchase order number. Table 4-1 lists the subassemblies and their FTS part numbers.

Table 4-1 List of Subassemblies

Reference Designator	Assembly Name	FTS Part Number
A1	Oscillator	05818-503
A2	RF Box Assembly	02494-501
A2A1	1 & 10 MHz Output PCB Assembly	02830-501
A3	Monitor PCB Assembly	06722-501

4.2 SUGGESTED TEST EQUIPMENT

Table 4-2 Suggested Test Equipment List

Test Item	Required Characteristics		Purpose/Use	Examples of Appropriate Equipment
Power Supply	Power Range:	0 to 28 V 0 to 3 A	Troubleshooting	Lambda LA-532
Multimeter	4 ½ Digit Display		Troubleshooting Adjustments	Data Precision 2480R
Oscilloscope	Freq. Response: Sensitivity: Cal. Sweeps:	60 MHz 10 mV/div 2 s to 0.1 s/div	Performance Checks Troubleshooting	TEK 2213
Frequency Reference	Accuracy, stability, and phase noise commensurate with FTS 1050A		Performance Checks	FTS 1050A/015; FTS 9500
Frequency Comparator	Frequency: Linear Out.:	10 MHz 0 to 1 V dc	Performance Checks	FTS 6102
Strip Chart Recorder	Speed: Span:	3 cm/hr 1, 10 V/fs	Performance Checks	Soltec S4201
Time Interval and Frequency Counter	Frequency: Sensitivity: Accuracy: 10 digit display	0 to 10 MHz 100 mV 10 ns	Performance Checks Troubleshooting	HP 5328A

4.3 OSCILLATOR TUNING ADJUSTMENT

Paragraph 3.5 supplies procedures for re-tuning the oscillator. It is suggested that the oscillator be re-tuned when the CONTROL monitor is <1 V or >4 V.

Note: The ratio between frequency change and monitored control voltage is 8×10^{-8}/Volt.

4.4 TROUBLESHOOTING GUIDELINES

The FTS 1050A needs little maintenance. Should a malfunction occur:

- Check the input power for proper level and connection.
- Check the fuse.
- Check the output signal connections and verify that they are not loose or shorted.
- Verify that the CONTROL VOLTAGE switch assembly is at the desired setting.

4.5 RESHIPMENT

4.5.1 Repacking

No special preparation other than standard packing procedures are required to protect the instrument during shipment. Connectors should be protected with connector covers or the instrument should be wrapped in plastic before packaging. Custom foam packing material is preferred because it conforms to the shape of the instrument. Take special care to protect the front and rear panels.

4.5.2 Equipment Return Procedure

To return this unit to the factory for repair:

1) Obtain a return authorization from FTS prior to returning the unit for service. Call FTS Customer Service (1-508-927-8220) for a return authorization.

2) Provide a description of the trouble, unit model number, serial number, and warranty expiration date.

3) Provide return shipping information (customer field contact, address, phone number, etc.).

4) Ship the unit to FTS, transportation prepaid and insured, with the Return Authorization Number and unit serial number clearly marked on the outside of the carton, to:

Frequency and Time Systems, Inc.
34 Tozer Road
Beverly, Massachusetts, 01915
Attn: Technical Service Department

CHAPTER 5 OPTIONS

5.0 INTRODUCTION

This chapter provides information regarding options for the FTS 1050A. The information is supplemental to the first four chapters and should be integrated with them. Specifications, control functions, indicators, operational procedures, etc. remain as presented in Chapters 1 through 4 unless modified within this chapter.

5.1 OPTION 001 100 kHz OUTPUT

5.1.1 OPTION DESCRIPTION

Option 001 adds a buffered 100 kHz output to the FTS 1050A. The output signal is sinusoidal with an amplitude of 1 V rms/50 Ω and is available via a rear panel BNC connector (see Figure 2-3).

An additional PCB Assembly is used in the RF Assembly to produce the 100 kHz output. This output is derived from a 10 MHz input provided by the 1 & 10 MHz Assembly. Figure 5-1 is a block diagram of the RF Assembly with the 100 kHz PCB Assembly.

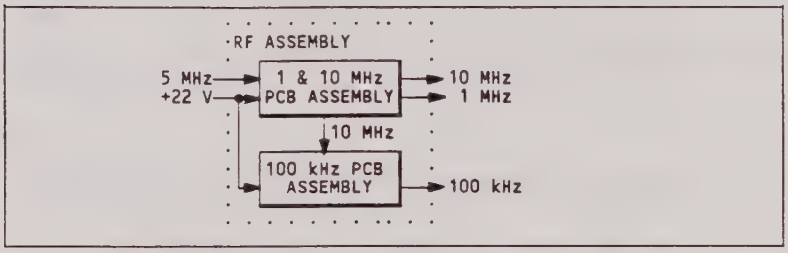

Figure 5-1 Block Diagram, RF Assembly with 100 kHz Option

5.1.2 SPECIFICATIONS

Table 5-1 Specifications Option 001, 100 kHz Output

Parameter	Specification
Output	100 kHz
Output Amplitude/50 Ω	1 V rms
Harmonic Distortion	-40 dB
Spurious Signals	-70 dB
Connector	BNC

5.1.3 INSTALLATION

No additional installation is required.

5.1.4 OPERATION

No operational controls, monitors, or indicators of the FTS 1050A are affected.

5.1.5 MAINTENANCE

Except for a change in the RF Box subassembly configuration, all information presented in Chapter 4 is valid for an FTS 1050A with Option 001.

5.1.5.1 Replaceable Subassemblies

Table 5-2 is a list of additional and/or replacement subassemblies included with Option 001.

Table 5-2 List of Subassemblies

Reference Designator	Assembly Name	FTS Part Number
A2	RF Box Assembly	02494-502
A2A1	100 kHz PCB Assembly	02465-501

5.2 OPTION 002 INTERNAL BATTERY AND CHARGER

5.2.1 OPTION DESCRIPTION

Option 002 adds an internal battery and battery charger to the FTS 1050A. The internal battery is a +28 V (nominal), 14 cell, sealed, lead acid battery pack, with a rated capacity of 5 AH. The battery furnishes up to 12 hours of continuous operation (@ 25 °C).

In the event of an external power loss, the instrument automatically switches to operate from the internal battery. If both the external AC and DC power sources are absent, the internal battery continues to operate the instrument until it is discharged below a pre-set level. When the cut-off point is reached, the battery is switched out and the FTS 1050A turns off, preventing permanent damage.

This option supplies full battery charging capabilities. The charge level of the internal battery is continuously monitored.

5.2.1.2 Functional Description

With Option 002, the Monitor PCB Assembly is replaced with a Controller PCB Assembly. The controller contains circuitry for:

1) Testing the battery,

2) Battery voltage and charging current monitoring,

3) Charging control circuitry,

4) Power source switching, and

5) Performing the functions described in Section 1.5.1.

5.2.1.3 Specifications

Table 5-3 Specifications, Option 002 Internal Battery

Parameter		Specification
Voltage		28 V dc (nominal)
Number of Cells		14; 2 V/cell
Battery Capacity (@ 25 °C)		5 AH
Low Voltage Cut-off Level		<26 V dc
Recharge Time		16 hours maximum
Storage Temperature		0 to +60 °C
Storage Time	@ 0 °C @ 23 °C @ 60 °C	7,200 days (18 years) 1,200 days (3 years) 60 days
Weight		12 lbs (5.5 kg)

5.2.1.4 Storage Requirements

Prior to placing the instrument into storage, the internal battery should be brought to a fully charged condition by operating the instrument from AC power for a suitable length of time (16 hours maximum for discharged batteries).

Store the FTS 1050A/002, in an dry area with an ambient temperature between -40 to 60 °C. Ensure that the battery fuse is removed before storing the instrument.

At storage temperatures of 35 °C and above, the battery should be recharged periodically on a schedule determined by the storage temperature (see Table 5-4). To insure the most efficient recharge cycle, recharge the batteries at an ambient temperature of 25 ± 10 °C.

Table 5-4 Battery Recharge Time Table

Temperature	Time before Recharge
<35 °C	24 mo.
45 °C	12 mo.
55 °C	6 mo.
60 °C	3 mo.

5.2.3 INSTALLATION

Place a 1 A fuse in the rear panel connector labeled BATT FUSE (see Figure 2-3).

NOTE: This fuse must be removed to disconnect the batteries.

5.2.4 OPERATION

5.2.4.1 Turn-On Procedure with Option 002

NOTE: Remove the battery fuse before warming-up the instrument! The oscillator draws excessive current during warm-up.

The turn on procedure is the same as detailed in Section 3.2. After completing Section 3.2, install the rear panel battery fuse.

5.2.4.2 Turn-off Procedure with Option 002

NOTE: The battery fuse must be removed when the unit is turned off or the battery continues to operate the FTS 1050A until it is discharged to <26 V.

1) Remove the 1 A fuse from the BATT FUSE receptacle located on the rear panel of the instrument.

2) Remove external power (AC and DC).

5.2.4.3 Indicators, Controls, and Monitors

Tables 5.2-3, -4 and -5 list the indicators, controls, and monitors that are activated with Option 002. These items are accessible at the front panel of the FTS 1050A. Refer to Figure 3-1 for their locations.

Table 5.2-3 Option 002 Indicators

Item#	Designation	Color	Description
9	BATTERY ON	Green	On = FTS 1050A is operating from the internal battery.
10	BATTERY CHARGE	Yellow	On = Battery is being charged. Indicator blinks when the battery is near full capacity.

Table 5.2-4 Option 002 Controls

Item#	Designation	Description
11	BATTERY TEST	Disconnects external power to test the internal battery. If the battery is faulty, AC power is reconnected without affecting instrument performance. Battery level can be read on the front panel meter.

Table 5.2-5 Option 002 Monitors

Pos.#	Designation	Range	Normal	Description
4	CHARGE	0 to 5 V	1 to 2 V	Represents the charge current to the battery. 1.5 V during trickle charge. 4.5 V during fast charge. BATTERY CHARGE indicator is on.
5	BATT	2.6 to 3.0 V	2.5 to 3.5 V	Represents the battery voltage (scale = 1/10). This monitor is active only when operating on internal battery or when the BATTERY TEST switch is depressed.

5.2.4.4 Operation on External Power with Option 002

All operational controls, indicators and monitors operate as described in Section 3 when Option 002 is included. The main difference is that switch-over to battery, low voltage cut-out, and battery charging functions have been added. These functions are described in the following sections.

The hierarchy of power sources is:

1) AC
2) External DC
3) Battery.

5.2.4.4.1 AC power

When operating on AC power, the battery charge is maintained, the BATTERY indicators (ON and CHARGE) and monitors (BATT and CHARGE) are enabled.

5.2.4.4.2 DC power

NOTE: Operation on external DC power does not maintain charge to the internal battery. External DC should be a temporary source of power when Option 002 is included.

While operating on external DC, the internal battery charging circuit is disabled and the battery CHARGE indicator and CHARGE monitor are inactive.

The low-voltage protection circuitry turns the FTS 1050A off if the external voltage drops below 26 V dc. The low-voltage cut-off is automatically reset at restoration of AC input power.

5.2.4.5 Operation on Internal Battery

When the FTS 1050A is operating from the internal battery, the BATTERY ON and AC ALARM indicators are lit. Operation from battery power can be selected removing all external power (AC and DC).

When the battery voltage drops below 26 V dc, it is disconnected and the instrument turns off. The battery low-voltage cut-off relay is automatically reset upon restoration of AC power. For maximum cycle life, always recharge the internal battery by applying AC power, as soon as possible after discharge.

5.2.4.6 Battery Monitoring

5.2.4.6.1 Battery voltage

When operating under battery power, the battery voltage level can be read on the MONITOR meter by selecting MONITOR switch position 5. BATT.

To monitor the battery level while operating on external AC or DC power:

1) Set the MONITOR switch to position 5. BATT.

2) Push and hold the BATTERY TEST button. Observe that the BATTERY ON indicator lights.

3) Read the MONITOR meter and verify that the battery voltage reads between 2.6 and 3.1 V (26 to 31 V dc).

If the battery voltage is above 26 V and stays above 26 V under load, the FTS 1050A continues to operate on the battery as long as the test button is depressed. If the battery voltage drops below 26 V, the controller automatically switches back to the external power source without interruption of normal operation.

5.2.4.6.2 Battery charging current

The internal battery is normally in a trickle charge condition whenever AC power is applied and the battery fuse is installed, to maintain the battery at maximum capacity. After the battery has been discharged and AC power is restored, the charger automatically recharges the battery; first at a fast charge rate (CHARGE indicator on), then tapering to a slower rate (CHARGE indicator blinking at 30 s intervals) and finally to a trickle rate (CHARGE indicator may not blink at all). The full charge cycle is completed in 12 to 16 hours.

The charge current can be monitored by selecting position 4. CHARGE on the MONITOR meter. The meter range is ±50 mA full scale when the charge indicator is off and ±500 mA when the indicator is on.

NOTE: The fast charge is inhibited during oscillator oven warm-up; the battery charger remains in the trickle mode, regardless of the state of the battery, until the OVEN READY indicator lights.

5.2.5 MAINTENANCE

5.2.5.1 Replaceable Subassemblies

Table 5.2-6 is a list of additional and/or replacement subassemblies included with Option 002.

Table 5.2-6 List of Subassemblies

Reference Designator	Assembly Name	Part Number
A3	Controller PCB Assembly	02496-501 (FTS)
*BT1	Battery, 12 V	0800-0016 (Gates)
*BT2	Battery, 8 V	0800-0027 (Gates)
*BT3	Battery, 8 V	0800-0027 (Gates)
F2	Fuse, 1 A	318001 (Littlefuse)

*BT1, 2 and 3 wired in series comprise the Battery Assembly.

5.2.5.1 Battery Replacement Procedure

1) Remove external power to the FTS 1050A.

2) Remove the rear panel BATT fuse.

3) Remove the top cover

4) Unscrew the battery bracket thumbscrew and remove the bracket.

5) Remove the clip-on battery leads.

6) Remove the Battery Assembly.

7) Repeat Steps 1 to 6 in reverse order to replace the Battery Assembly.

5.3 OPTION 003 1 PPS OUTPUT

5.3.1 OPTION DESCRIPTION

Option 003 adds a 1 PPS output to the FTS 1050A. The 1 PPS output is a TTL compatible squarewave and can be synchronized to an external reference. The 1 PPS output signal is accessible at a rear panel BNC connector.

An additional PCB Assembly is included to generate the 1 PPS signal. The signal is derived from a 10 MHz input from the RF Assembly (refer to Figure 5-2) by digital division. The 1 PPS PCB Assembly also contains circuitry for synchronizing the 1 PPS output signal to an external reference.

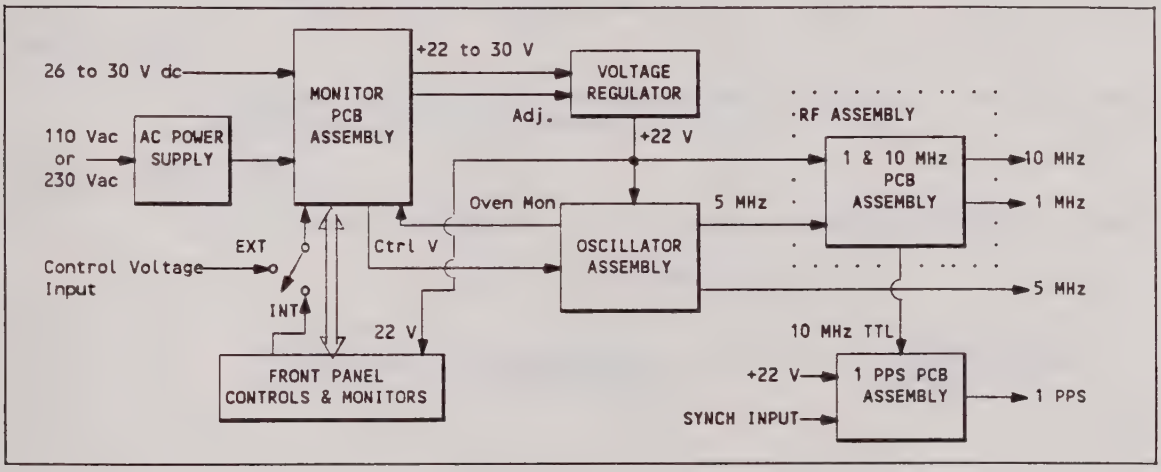

Figure 5-2 FTS 1050A Quartz Frequency Standard Block Diagram (with Option 003)

5.3.2 SPECIFICATIONS

Table 5-9 Specifications, Option 003 1 PPS Output

Parameter	Specification
1 PPS Output Signal Amplitude	 TTL Compatible
Synchronization Input Amplitude Frequency Rise Time	 3 to 10 V into 50 Ω 1 Hz <30 ns

5.3.3 INSTALLATION

No additional installation is required.

5.3.4 OPERATION

5.3.4.1 1 PPS Synchronization

The 1 PPS output signal can be synchronized to within ± 400 ns of the rising edge of an external reference pulse. To synchronize:

1) Connect the reference pulse to the front panel BNC connector labeled 1 PPS SYNC IN. Ensure that this signal meets the requirements listed in Table 5-9.

2) Depress the front panel pushbutton labeled ENABLE for at least 1 second.

3) Remove the synchronization input.

5.3.5 MAINTENANCE

Except for the addition of the 1 PPS PCB Assembly, all information presented in Chapter 4 is valid for an FTS 1050A with Option 003.

5.3.5.1 Replaceable Subassemblies

Table 5-10 is a list of additional and/or replacement subassemblies included with Option 003.

Table 5-10 List of Subassemblies

Reference Designator	Assembly Name	FTS Part Number
A4	1 PPS PCB Assembly	02456-501

5.4 OPTION C16 HRC SIGNAL SOURCE

5.4.1 OPTION DESCRIPTION

Option C16 allows the FTS 1050A to serve as an accurate and stable frequency source for HRC (harmonically related carrier) systems. The FTS 1050A/C16 provides two independently buffered 6.0003 MHz outputs (rear panel, BNC connectors) supplied directly from the oscillator. These outputs are adjustable over a range of 2 Hz ($3x10^{-7}$) via front panel controls.

With this option, the 5 and 10 MHz outputs are deleted and no RF Assembly is included. This precludes the combination of either Option 001 (100 kHz output) or Option 003 (1 PPS output) with the 1050A/C16. Refer to Figure 5-3 for a block diagram of the 1050/C16 rear panel.

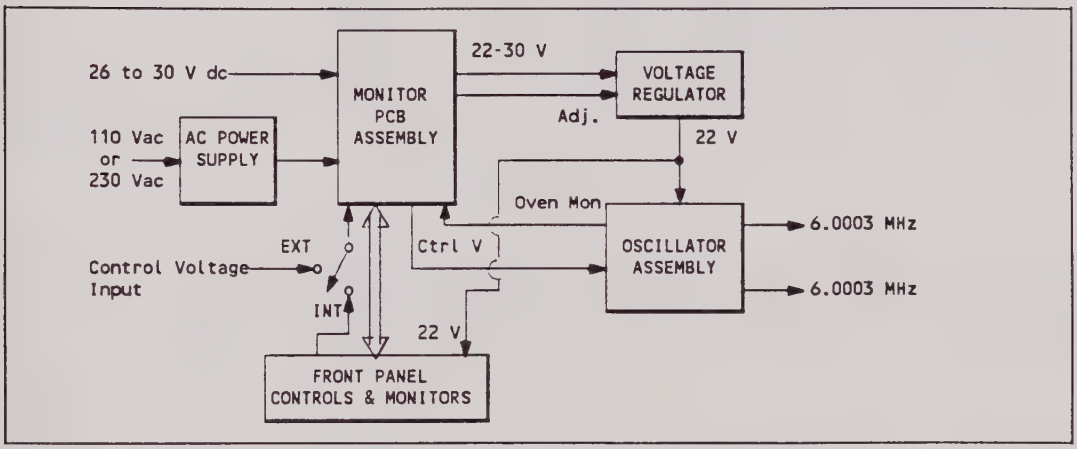

Figure 5-3 FTS 1050A Quartz Frequency Standard Block Diagram with Option C16

5.4.2 SPECIFICATIONS

Option C16 affects several performance specifications. Table 5-11 lists specifications that differ from those listed in Table 1-1. Specifications not listed in Table 5-11 remain the same as in Table 1-1.

Table 5-11 Specifications, Option C16 HRC Signal Source

Parameter		Specification
Outputs		Two at 6.0003 MHz
Short Term Stability		
For averaging time of:	1 s	2×10^{-12}
	10 s	2×10^{-12}
	100 s	2×10^{-12}
SSB Phase Noise (5 MHz Output, BW=1 Hz)		
For offset from signal of:	1 Hz	-110 dBc
	10 Hz	-128 dBc
	100 Hz	-134 dBc
	1000 Hz	-134 dBc

5.4.3 INSTALLATION

The only change to the installation instructions supplied in Chapter 2 is:

- The 5 and 10 MHz connections have been deleted and replaced with two rear panel BNC connectors for the 6.0003 MHz outputs.

Refer to Figure 5-4 for an illustration of the 1050A/C16 rear panel.

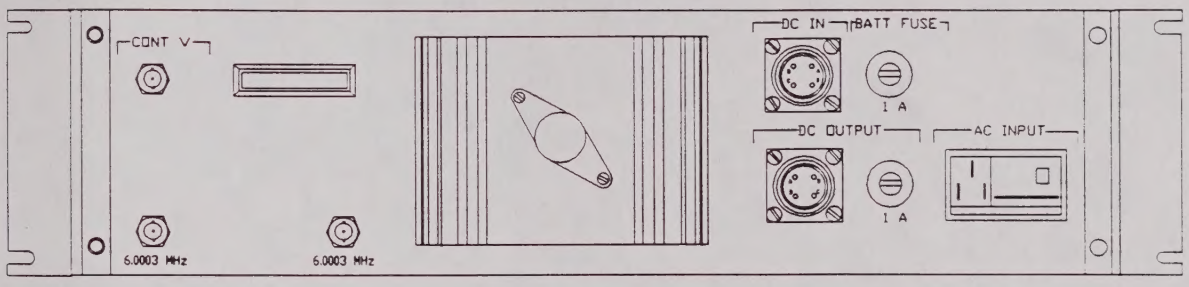

Figure 5-4 FTS 1050A/C16 Rear Panel

5.4.4 OPERATION

Information presented in Chapter 3 is applicable to the FTS 1050A/C16 with the exception of the internal frequency adjustment (Section 3.5.1). With Option C16, the maximum tuning adjustment using the CONTROL VOLTAGE switch assembly, is 3×10^{-7} and the minimum step is 3×10^{-12}.

5.1.5 MAINTENANCE

Except for the deletion of the RF Box Assembly, all information presented in Chapter 4 is valid for an FTS 1050A/C16.